

A METHOD OF PRODUCING A HOOD, AND A HOOD PRODUCED
ACCORDING TO THE METHOD

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A1 > ~~TECHNICAL FIELD~~

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The present invention relates to a method of producing a hood for a hearing protector, the hood being produced by injection moulding of plastic material.

10 The present invention also relates to a hood for a hearing protector in which the hood is produced from plastic by injection moulding.

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A2 > ~~BACKGROUND ART~~

15 A multiplicity of various acoustic hoods are previously known in the art for use in hearing protectors. Such hoods may be simple and consist of a cup-shaped shell injection moulded from plastic which is secured in one end of an arc which is placed over the head of the wearer and which has a similar hood at its opposite end. The hoods are dimensioned to enclose the wearer's ears.

20 A hood consisting exclusively of a shell is, despite quite complicated configuration, readily subjected to vibrations and oscillations, throughout the entirety of the hood or only locally in it, which implies that the sound-suppression or sound insulation which the hood achieves will be unpredictable and uneven within various frequency ranges.

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In order to obviate the above-mentioned problem, various inlays of different sound-absorbing materials have been placed interiorly in the hood. Such solutions also suffer from similar drawbacks.

30 EP 484 306 discloses a hearing protector in which the hoods have a hard outer shell, inside this a casing of compressed foamed plastic, and inside this casing a further hard hood, which realises compression of the foamed layer lying outside. Interiorly in the inner hood, a sound-absorbent material is then placed.

Such a construction functions considerably better than the above-described construction consisting merely of a shell which is provided interiorly with a sound-absorbent. However, the construction is not optimal, either as regards rational production or sound-suppression/sound-insulation.

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Similar constructions are also known from USPS 2 684 067, DE 3 441 120, DE 3 441 122, and others.

For a hood to be as favourable as possible in a hearing protector, the material in the hood should be "as dead as possible" so that it has a very slight ability to be excited into oscillation movements both as an entity and also locally.

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A3 ~~PROBLEM STRUCTURE~~

15 The present invention has for its object to form the method intimated by way of introduction such that it is possible, according to the method, to manufacture a hood which obviates the drawbacks inherent in hoods according to prior art technology, and in particular to improve the sound-suppression capability of the hood. The present invention further has for its object to form the method such that it permits extremely rational production of hoods, at the same time as these can be given an extremely aesthetically attractive appearance.

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The present invention also has for its object to design the hood intimated by way of introduction such that this obviates the drawbacks inherent in prior art designs and constructions, and in particular improves the sound-suppression capability of the hood. Finally, the present invention also has for its object to design the hood such that this may be manufactured economically and rationally in large series and that it may be given an aesthetically attractive exterior.

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a 30 ~~SOLUTION~~

The objects forming the basis of the present invention will be attained in respect of the method if this is characterised in that the hood is injection moulded to one

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A6 > single continuous piece using plastic materials with different properties in at least one respect.

As regards the hood, the objects of the present invention will be attained if the hood is characterised in that it includes at least two mutually contiguous portions or layers which consist of plastic material with different properties in at least one respect.

By injection moulding of a hood where different portions are included in the hood, and where the injection moulded plastic material or materials have different properties in at least one respect, a hood will be realised which suffers from considerably less of a risk of being subjected to resonance oscillations both locally and for the hood as an entity. The hood will have improved sound-suppression capability.

Further, the possibility is afforded of extremely rational manufacture.

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A7 > **BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS**

The present invention will now be described in greater detail hereinbelow, with particular reference to the accompanying Drawings. In the accompanying Drawings:

Fig. 1 is a perspective view of a part of a hearing protector employing a hood according to the present invention;

Fig. 2 is a cross section through a first embodiment of a hood according to the present invention; and

Fig. 3 is a partial cross sectional, on a larger scale, of a second embodiment of a hood according to the present invention.

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A8~~DESCRIPTION OF PREFERRED EMBODIMENT~~

5 The basic concept behind the present invention is that there should be included, in one and the same hearing protector hood, at least two portions where the material in each portion differs in one way or another as regards oscillation from the material in the other portion or in the remaining portions. Differences which will be topical for consideration here are differences in density, differences in hardness, differences in modulus of elasticity, differences in structure, for example differences between homogeneous and porous plastic materials, 10 differences between plastic materials with open or closed foamed structure, differences between plastic materials with and without different types of fillers, etc. As examples of usable plastics, mention might be made of ABS plastic, polypropylene, polyethylene and polycarbon plastics, TPE, etc.

15 The concept which lies behind the present invention takes as its point of departure the fact that a sound wave, i.e. a mechanical oscillation movement, which propagates in a body will at least partly be reflected and refracted when it impinges on an interface between materials with different properties. The reflected and refracted parts of the sound wave will interfere with each other and 20 with the original sound wave, with a diffusion and attenuation of the sound wave as a result. This phenomenon becomes more manifest the higher the frequency the sound wave has.

If one considers a body, e.g. a hood included in a hearing protector, its oscillation 25 properties are determined by material properties, configuration and dimensions. Different materials oscillate at different frequencies if the remaining properties remain constant. If two bodies which oscillate at different frequencies (e.g. depending upon different material properties in the bodies) are mechanically interconnected, the different oscillations will inhibit one another, whereby 30 resonances are obstructed or reduced.

In Fig. 1, reference numeral 1 relates to a hood included in a hearing protector, the hood being pivotally secured in a stirrup 2 which is intended to extend over the

head of the wearer of the hearing protector. On the side of the hood 1 facing towards the wearer's head, there is provided an abutment ring 3 which is produced from soft, resilient and yieldable material so that it may form itself according to the head of the person wearing the hearing protector, and thereby realise a seal
5 between the interior of the hood, round the ear of the wearer and the ambient surroundings.

When the word "hood" is employed below and in the appended Claims, this refers exclusively to the hood proper without loosely inserted damping material or other
10 equipment and also without the above-mentioned abutment ring.

In the embodiment according to Fig. 2, the hood 1 is produced by injection moulding in accordance with the sandwich method. The hood 1 has a peripheral edge 4 facing towards the wearer's head and along which the above-mentioned
15 abutment ring 3 is secured.

On its outside, the hood 1 has a sprue 5 via which molten plastic material is injected in under high pressure into the mould in which the hood 1 is produced. According to the sandwich method, a first plastic material which is to form the
20 outer casing 6 of the hood and its inner casing 7 is injected in first. When injection of this first plastic material is completed, the injection continues with a second plastic material which is injected interiorly in the material which formed the outer casing and the inner casing. The first and second plastic materials have different material properties in at least one respect, such as density, hardness, etc. The
25 second plastic material forms an intermediate layer 8 between the outer casing 6 and the inner casing 7. It should be observed that the outer casing 6 and the inner casing 7 have a connecting bridge 9 along the peripheral edge 4 of the hood 1. As a result, the material in the intermediate layer 8 will in principle be totally enclosed between the outer casing and the inner casing, possibly apart from the
30 region at the sprue 5.

On injection moulding according to the sandwich method, the plastic material for the outer casing and the inner casing is fed to the moulding tool via a first feeder

screw included in the injection moulding machine. A second feeder screw is employed for injecting the second material for the intermediate layer 8, in which event the tool may either have two separate inlets, one for each screw, or the tool may also be switched from a position for injection via the first screw to a position
5 for injection via the second screw.

In the embodiment according to Fig. 1, the hood 1 has an outer, peripheral portion 10 which extends along the periphery of the hood apart from in its upper region. The bottom of the hood, i.e. substantially its central region, and its upper region
10 are formed from a central portion 11 which is discrete from the outer portion 10 via a separation line 12 which, in practice, is only visual since the material in the outer portion 10 and the central portion 11 in principle form a single, contiguous piece where the different portions have materials with different properties.

15 In one variation of the embodiment according to Fig. 1, the outer portion 10 has a through-going material thickness such that the hood 1 has the same material externally and internally within the region which is defined by the outer portion 10. The corresponding feature naturally applies to the central portion 11.

20 In another variation of the embodiment according to Fig. 1, the material within the outer portion 10 is double, with an outer layer which has a free surface on the outside of the hood, and an inner layer whose material differs from the material in the outer layer. The corresponding applies to the central portion 11, but however the materials in the outer and inner layers have been reversed, so that the material
25 in the outer layer of the outer portion lies on the inside of the central portion 11, while the material in the outer layer within the central portion 11 lies on the inside of the outer layer in the outer portion 10. In the region of the separation line 12, the layers have mutually corresponding apertures and bridges, which will be illustrated more clearly with reference to Fig. 3.

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Fig. 3 shows a duplex layer construction where the division between the layers may have any optionally formed separation lines which can define considerably

more different regions than applies in Fig. 1, where only two different regions are shown.

5 In the embodiment according to Fig. 3, the shell 1 has, in its upper region in the Figure, a soft inner layer 13 and a hard outer layer 14. The two layers 13 and 14 are united to one another in a union interface where the materials have been caused to adhere powerfully to one another, possibly by fusion, during the injection moulding cycle proper. In the lower region of the embodiment according to Fig. 3, the soft material is outermost and forms an external band 13' along the
10 peripheral edge 4 of the hood 1. On the inside of this external band 13', the hard material is located and there forms an inner band 14'.

The transition region between the edge area 16 of the hood 1 and its cupola area 17 includes alternatingly disposed bridges 18 and complementary apertures 19
15 accommodating the bridges 19.

As will be apparent from Fig. 1, an abutment ring 3 extends along the peripheral edge 4 of the hood 1. This has a carrier ring 20 with catches 21 or a circumferential ring for snapping into a groove 22 in the inside of the inner, hard
20 band 14'. For the satisfactory function of the hearing protector, it is of vital importance that a good seal is obtained, on the one hand, between the interior of the hood 1 and the abutment ring 3 and, on the other hand, between the abutment ring 3 and the head of the wearer of the hearing protector. In the embodiment illustrated in Fig. 3, the outer, soft band 13' has been given the form of a seal 23
25 which abuts elastically compressed against the upper side of the carrier ring 20.

The division between the portions 10 and 11 of the hood 1 shown in Fig. 1 has been made merely for purposes of exemplification. Aesthetic considerations may be made in this design, without appreciably affecting the acoustic properties of the
30 hood. On the other hand, it might possibly be expected that a division into more than two different contiguous portions may have a favourable effect on the acoustic properties of the hood.